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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/802,468	03/09/2001	Kenneth J. Ruchala	066744-0012	5869
20572	7590	11/16/2004	EXAMINER	
GODFREY & KAHN S.C. 780 NORTH WATER STREET MILWAUKEE, WI 53202			DASTOURI, MEHRDAD	
			ART UNIT	PAPER NUMBER
			2623	

DATE MAILED: 11/16/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

**Application No.**

09/802,468

**Applicant(s)**

RUCHALA ET AL.

**Examiner**

Mehrdad Dastouri

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 01 July 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-14 and 17-191 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1,10-13,20-40 and 104-125 is/are allowed.
- 6) ☒ Claim(s) 2-9, 14, 16-19, 41-43, 45-103 and 126-191 is/are rejected.
- 7) ☒ Claim(s) 44,65,86,130,152 and 174 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114.

Applicant's submission filed on July 1, 2004 has been entered.

### ***Response to Amendment***

2. Applicants' amendment filed July 1, 2004, has been entered and made of record.

3. 35 U.S.C. 112, second paragraph rejection of claims 14-18 has been withdrawn in view of Applicants' amendment.

4. Applicants' arguments have been fully considered.

Applicants' arguments concerning Claim 1 element of that "the second image being separate and independent from the first image and obtained from the patient at a different time from the first image, the second image including complete image data" is not persuasive. The second image taught by Arata is also obtained at a different time and is independent from the first image.

Applicants' arguments regarding combined limitations recited in Claim 1 are persuasive, and rejection of Claim 1 and its dependent claims have been withdrawn.

***Claim Rejections - 35 USC § 112***

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 14, 17, 18, 63-82 and 148-169 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In Line 11 of Claims 14 and 148, "realigning the second image to the first image" is vague and indefinite. No preceding alignment processing has been recited in the Claim prior to the step of realigning.

In Line 13-15 of Claims 14 and 148, "merging the first sinogram data set... to obtain an augmented sinogram data set;" is vague and indefinite. The sinogram dataset that the first sinogram data set is augmented to is not identified.

Claims 17, 18, and 63-82 depend on Claim 14. Claims 149-169 depend on Claim 148.

***Claim Objections***

7. Claims 19, 83-103 and 170-191 objected to because of the following informalities:

In Line 7 of Claim 19 and Line 8 of Claim 170, "fusing" should be corrected to aligning". Claims 83-103 depend on Claim 19. Claims 171-191 depend on Claim 170.

Appropriate correction is required.

***Claim Rejections - 35 USC § 102***

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

9. Claims 2, 3, 5, 9, 14, 18, 19, 41, 42, 60-63, 81-84, 102, 103, 126-128, 146-150, 168-172, 190 and 191 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Arata (U.S. 5,552,605).

Regarding Claim 2, Arata discloses a method of augmenting a tomographic projection image of a patient, the method comprising the steps of:

converting a first limited data sinogram obtained from a patient to a first limited image the first limited data sinogram and the first limited image including incomplete or imperfect data ( Column 2, Lines 23-25 and Column 3, Lines 65-66);

fusing the first limited image to a second complete image. the second complete image being separate and independent from the first image and obtained from the patient at a different time from the first limited image, the second complete image including complete image data to obtain a transformed complete image (Column 4, Lines 37-40; Column 4, Lines 45-48, "composite". The second image is inherently obtained at a different time and is independent from the first image.);

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reprojecting a sinogram data set from the transformed complete image to obtain a reprojected complete data sinogram (Column 4, Lines 32-34; extracts deviations, Column 4, Lines 34-38);

augmenting the first limited data sinogram with additional data obtained from the reprojected complete data sinogram to obtain an augmented limited data sinogram (Column 4, Lines 37-40); and

converting the augmented limited data sinogram into an augmented image (Figure 2; Column 4, Lines 42-50).

Regarding Claim 3, Arata further discloses the method according to Claim 2 wherein the step of fusing comprises the steps of extracting certain features from the first limited image and the second complete image and registering the features into the transformed complete image (Translator adjusts for cumulative offset, Column 4, Lines 36-39).

Regarding Claim 5, Arata further discloses the method according to Claim 2 wherein the step of fusing is performed automatically (Column 4, Lines 36-41).

Regarding Claim 9, Arata further discloses the method according to Claim 2 further comprising the steps of using the augmented image any one of the Following: contouring, patient setup (Figure 1; Column 2, Lines 59-67, Column 3, Lines 1-28), patient repositioning, dose registration, dose calculation, dose patching, dose reconstruction, dose verifications delivery modification, plan selection, replannning, re-optimization, delivery verification, deformable patient registration, and deformable dose registration.

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With regards to Claims 14, 19, 126, 148 and 170, arguments analogous to those presented for Claim 2 are applicable to Claims 14, 19, 126, 148 and 170.

With regards to Claim 18, arguments analogous to those presented for Claim 14 are applicable to Claim 18.

Regarding Claim 41, Arata further discloses the method according to Claim 2 wherein the first limited data sinogram is converted to an artifact-prone image (Column 4, Lines 56-64).

Regarding Claim 42, Arata further discloses the method according to Claim 2 wherein the step of fusing comprises using common radiotherapy setup protocols (Figure 1; Column 1, Lines 61-67, Column 2, Lines 1-26).

Regarding Claim 60, Arata further discloses the method according to Claim 2 wherein the step of augmenting data utilizes patient shape, size, or density information (Column 2, Lines 2-26).

Regarding Claim 61, Arata further discloses the method according to claim 2 wherein the patient's size, shape, and/or anatomy has changed between the collection of the first and second images or data sets (Column 2, Lines 2-26).

With regards to Claims 62, 83, 127, 149 and 171, arguments analogous to those presented for Claim 41 are applicable to Claims 62, 83, 127, 149 and 171.

With regards to Claims 63, 84, 128, 150 and 172, arguments analogous to those presented for Claim 42 are applicable to Claims 63, 84, 128, 150 and 172.

With regards to Claims 81, 102, 146, 168 and 190, arguments analogous to those presented for Claim 60 are applicable to Claims 81, 102, 146, 168 and 190.

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With regards to Claims 82, 103, 147, 169 and 191, arguments analogous to those presented for Claim 61 are applicable to Claims 82, 103, 147, 169 and 191.

***Claim Rejections - 35 USC § 103***

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 4, 6, 17, 43, 45-55, 64, 66-76, 85, 87-97, 129, 131-141, 151, 153-163, 173 and 175-185 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arata, further in view of Hibbard et al., (hereinafter Hibbard), (U.S. 6,266,453).

As per Claim 4, Arata does not teach fusing manually. However, Hibbard teaches:

wherein the step of fusing is performed manually (Column 5, Lines 50-53).

It would have been obvious to one of ordinary skill in the art to use the manual fusing techniques taught by Hibbard in the system of Arata to focus only on those regions of genuine interest in the image data.

As per Claim 6, Arata does not teach fusing using geometric features. However, Hibbard teaches:



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wherein the step of fusing is performed using geometric features (Column 11, Lines 36-40, 50-65) or voxel-similarity techniques (Column 6, Lines 48-52 or Column 11, Lines 4-9).

It would have been obvious to one of ordinary skill in the art to use the manual fusing techniques taught by Hibbard in the system of Arata to use geometric features because it will provide more accurate enhanced image for subsequent diagnostic purposes.

Regarding claims 45-52, Arata does not explicitly disclose the first limited data sinogram and the second complete image is obtained from images obtained from different modalities (MRI, CT, Pet).

Hibbard teaches the first limited data sinogram and the second complete image is obtained from images obtained from different modalities (MRI, CT, Pet) (Column 1, Lines 21-40).

It would have been obvious to one of ordinary skill in the art to use the techniques taught by Hibbard in the system of Arata to obtain the first limited data sinogram and the second complete image from images obtained from different modalities (MRI, CT, Pet) because it will utilize certain strength of each modality to provide a more complete representation of the internal anatomy of the patient (Hibbard; Column 1, Lines 21-40).

Regarding Claim 53, Arata does not teach the method according to Claim 2 further comprising the step of completing one or more iterations by substituting the augmented image for the first limited image.

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Hibbard teaches completing one or more iterations by substituting the augmented image for the first limited image (Column 10, Lines 4-11).

It would have been obvious to one of ordinary skill in the art to use the iteration techniques taught by Hibbard in the system of Arata because it will provide more accurate enhanced image for subsequent diagnostic purposes.

Regarding Claim 17, considering iterative processing taught by Hibbard, combined teachings of Arata and Hibbard disclose the method according to Claim 14 wherein the second sinogram data set includes limited data, but is less-limited or limited in a different manner than the first sinogram data set such that the first sinogram data set can be augmented from the second sinogram data set or the reprojected sinogram data set (Arata, Column 1, Lines 61-67, Column 2, Lines 1-20; Hibbard Column 10, Lines 4-11).

Regarding Claim 43, considering iterative processing taught by Hibbard, combined teachings of Arata and Hibbard disclose the method according to claim 2 wherein the first limited image and the second complete image are sufficiently well aligned that explicit fusion is not necessary (Arata, Column 1, Lines 61-67, Column 2, Lines 1-20; Hibbard Column 10, Lines 4-11).

Regarding Claim 54, Arata teaches the method according to Claim 2 wherein the first limited data sinogram is obtained from a tomographic or volume-imaging modality (Column 1, Lines 6-11).

Regarding Claim 55, Arata teaches the method according to Claim 2 wherein the second completed data sinogram is obtained from a tomographic or volume-imaging modality (Column 1, Lines 6-11).

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With regards to Claims 64, 85, 129, 151 and 173, arguments analogous to those presented for Claim 43 are applicable to Claims 64, 85, 129, 151 and 173.

With regards to Claims 66-76, 87-97, 131-141, 153-163 and 175-185, arguments analogous to those presented for Claims 45-52 are applicable to Claims 66-76, 87-97, 131-141, 153-163 and 175-185.

12. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arata (U.S. 5,552,605) in view of Basu et al (U.S. 6,282,257).

Regarding Claim 7, Arata generally discloses the method according to Claim 2 wherein the first limited data sinogram, the reprojected complete data sinogram and the augmented data sinogram is represented by an angle a distance (Column 3, Lines 5-29).

However, Arata do not explicitly discloses a matrix of angle and distance data.

Basu et al, in the same field of endeavor for reprojecting a sinogram to a tomographic image, teaches a fast hierarchical backprojection method for imaging wherein the limited data sinogram, the reprojected sinogram and the augmented limited data sinogram is represented by a data matrix wherein each row represents an angle and each column represents a distance (Figures 2 and 3; Column 9, Lines 29-67, Column 10, Lines 1-19).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Arata's invention according to the teachings of Basu et al to implement further limitations recited in Claim 7 because utilizing a

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matrix is a standard representation routinely utilized in two-dimensional data calculations.

Regarding Claim 8, considering arguments presented for in Claim 7 and based on combined teachings of Arata and Basu, Arata further discloses the method according to Claim 6 further comprising the steps of comparing the data matrix of the reprojected complete data sinogram is to the data matrix for the first limited data sinogram and determining what data is missing from the first limited data sinogram (Column 1, Lines 61-67, Column 2, Lines 1-25).

13. Claims 56-59, 77-80, 98-101, 142-145, 164-167 and 186-189 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arata, further in view of Kudo et al. ("Helical-scan Computed Tomography Using Cone-Beam Projections, IEEE ISBN: 0-7803-0513).

Regarding Claims 56-59, Arata does not explicitly disclose obtaining sinograms using fan-beam, cone-beam or helical geometries.

Kudo et al disclose computed tomography imaging system using these well known geometries (Abstract; Figure 5).

It would have been obvious to one of ordinary skill in the art to use the techniques taught by Hibbard in the system of Arata to obtain sinograms using fan-beam, cone-beam, helical geometries, or to collect any of the sinograms or images using planar image or data converted into tomographic-equivalent images or sinograms, or volume images because these are the well known methodology routinely implemented in computed tomography.

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With regards to Claims 77-80, 98-101, 142-145, 164-167 and 186-189, arguments analogous to those presented for Claims 56-59 are applicable to Claims 77-80, 98-101, 142-145, 164-167 and 186-189.

***Allowable Subject Matter***

14. The following is an examiner's statement of reasons for allowance:

Claim 1 of the instant invention recites a method of augmenting a tomographic projection image of a patient, the method comprising the steps of:

obtaining a first sinogram data set from a patient including incomplete or imperfect data and reconstructing the first sinogram data set into a first image; aligning the first image to a second image, the second image being separate and independent from the first image and obtained from the patient at a different time from the first image, and including complete image data;

reprojecting the aligned image into a reprojected sinogram data set;

extracting data from the reprojected sinogram data set that is missing from or not available in the first sinogram data set;

augmenting the first sinogram data set with the extracted data from the reprojected sinogram data set to obtain an augmented sinogram data set; and reconstructing the augmented sinogram data set into a third image.

Claim 104 recites substantially analogous limitations as recited in Claim 1, and further utilizing a different apparatus or modality for obtaining the second image, and is therefore allowable.

The features identified, in combination, are neither discussed nor suggested by the prior arts of record.

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Claims 10-13 and 20-40 depend on Claim 1, and are therefore allowable.

Claims 105-125 depend on Claim 104, and are therefore allowable.

15. Claims 44 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 44 of the instant invention recites the method according to Claim 2 wherein the first limited data sinogram, the reprojected complete data sinogram and the augmented limited data sinogram are represented by a data matrix wherein each row represents a gantry position, a gantry angle, or a ray angle; and each column represents a detector number, a detector distance, a detector angle, or a ray position, and a third sinogram dimension may optionally represent multiple detector rows.

16. Claims 65, 86, 130, 152 and 174, recite analogous limitations as recited in Claim 44, and would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, and rewritten to overcome the 112 second paragraph rejection set forth in the Office Action.

#### ***Contact Information***

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mehrdad Dastouri whose telephone number is (703) 305-2438. The examiner can normally be reached on Monday to Friday from 8:00 a.m. to 4:30 p.m..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on (703) 308-6604. The fax

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phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Mehrdad Dastouri  
Primary Examiner  
Art Unit 2623  
November 13, 2004

MEHRDAD DASTOURI  
PRIMARY EXAMINER

